DEVICE FOR RECORDING INFORMATION IN DIFFERENT MODES

Field of the Invention

　　　　The present invention relates to a device for recording information of the type mentioned in the preamble to the appended claim 1.

5　Background of the Invention

　　　　In recent years, the use of computers has increased among many very geographically mobile occupational groups. One reason for this is that one can work more efficiently by having direct access to a large amount
10　of information while at the same time having good capabilities for processing new information simply and efficiently.

　　　　For this purpose, various types of portable computers have been developed. Equipped with suitable soft-
15　ware, these types of computers provide excellent capabilities for processing and managing information in text as well as image format.

　　　　A drawback of these portable computers is that inputting information by the intermediary of a key-
20　board is often time-consuming in comparison with the time required for processing the information once it has been fed into the computer. In order to achieve faster and more efficient inputting, there have been attempts at finding simpler ways of feeding the information into
25　the computer. In some cases, the text which is to be fed into the computer is replaced by a numerical code, for instance in the case of vehicle inspections. However, this requires more of the user, who has to keep track of several codes, which increases the risk of input errors.
30　　　　In the daily work of many occupational groups there is a need for a simple way of putting together image and text information. Examples of this include various types of service and maintenance staff who work from some type of protocol and who wish to verify that a certain opera-

tion has been carried out; policemen at the site of an accident who wish to gather image data as well as personal data concerning witnesses, etc.; and researchers and other individuals whose work involves information

5 retrieval and who wish to put together text and images from a number of different written documents.

In order to achieve more efficient inputting of information in these and similar situations one could use other input units, such as a scanner which records

10 text information from a surface when it is passed over the same and a digital camera which takes pictures and stores them digitally so that they can be transferred to a computer for processing.

Scanners of both the stationary and the portable

15 type are available. Stationary scanners are preferably used in connection with the recording of whole pages with printed text and image information, the scanner being passed over the page at a constant speed. The information is recorded by means of a light-sensitive sensor, which

20 in stationary scanners often consists of a line sensor.

However, in most of the above situations, rather than the recording of a whole page of information a more selective recording of information is desired and, moreover, the scanner must also be easy to carry. For this

25 reason, scanners of the hand-held type are much more interesting in these contexts. The sensors in these scanners can be either of the line type or of the two-dimensional type.

US 4,949,391, for example, discloses a hand-held

30 scanner for recording text. The scanner has a two-dimensional sensor, which records images of the underlying surface when the scanner is passed over the same.

Another hand-held scanner is described in US 5,301,234. This scanner utilises a line sensor which

35 records a sequence of vertical "slices" of the characters and of the spaces between them when the scanner is passed over the characters on the substrate. The "slices" are

stored in the scanner as a digital bitmap. To enable the
accurate recording of characters, the scanner is provided
with position means in the form of a wheel which must be
in contact with the underlying surface in connection with
5   the recording of the characters to record the position of
the scanner relative to the surface.

A drawback of using a computer, a scanner, and a
digital camera at the same time is that the equipment
becomes bulky and the user has to handle several units.

10   Thus, there is a need for equipment which is easy
to handle, enabling fast and reliable recording of selec-
tive text and image information in situations of the kind
described above in a format facilitating computer pro-
cessing of the same at a later time.

15   Summary of the Invention

The object of the present invention is to provide a
solution to the above-mentioned problems by providing an
improved device for recording information in text and
image format.

20   This object is achieved according to the invention
by a device having the features recited in the appended
claim 1, with preferred embodiments in the appended
claims 2-14.

The invention is based on the understanding that
25   with a light-sensitive sensor with a two-dimensional
sensor surface as the starting-point, a text recording
function, i.e. a "scanner function", as well as an image
recording function, i.e. a "camera function", can be
easily created in one and the same device. More
30   specifically, the device is adjustable between a first
mode, in which the device is adapted to essentially abut
against and be passed over a surface for imaging the same
by means of a plurality of images, and a second mode, in
which the device is adapted to image an object located at
35   a distance.

The device can be adjusted by the user or automati-
cally by the device if, for example, it detects that the

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distance to an object within its field of vision changes
more than a predetermined value. The adjustment involves
the adaptation of the device in some manner, e.g. physi-
cally or with respect to software, to make it suitable
5   for use in the mode in question.

The first mode, or the "scanner mode", is intended
for recording information located on a surface over which
the device can be passed. The surface need not be plane.
It is sufficient that it is even enough to enable the
10   device to be moved in contact with the surface or direct-
ly adjacent to the same. The information, which can be
said to be "two-dimensional" since it is located on a
surface, can be composed of character sequences, e.g. one
or several words or one or several sentences selected
15   from a longer text. The characters can be letters, num-
bers, or other written characters or symbols. It is pre-
ferably stored in character-coded format. However, the
information may also be composed of image information
which is scanned by passing the device over the surface
20   and recording a plurality of images of the image informa-
tion.

The second mode is preferably used for recording
"three-dimensional" information, i.e. when one is requir-
ed to take pictures of objects. Preferably, in this mode,
25   individual pictures are taken which are stored in image
format. Naturally, this mode can also be used for taking
pictures of surfaces from a distance, which are stored in
image format.

Preferably, the same sensor is employed in both the
30   first and the second mode, but it is also possible to use
one sensor for each mode. In the latter case, the adjust-
ment would involve changing the beam path in the device
so that the imaging takes place with the aid of one sen-
sor in the first mode and with the aid of the other sen-
35   sor in the second mode. The beam path can be changed by
adjusting one or more components in the device. Alterna-
tively, a first opening with a first fixed beam path can

be used in the first mode, and a second opening with
a second fixed beam path can used in the second mode.
Adjusting between the modes then comprises an adjustment
of which sensor is activated for imaging.

5   It should be noted in this context that a two-dimen-
sional sensor surface refers to the fact that the sensor
surface must be able to image a surface with a matrix of
pixels so that images with overlapping contents can be
recorded.

10   Preferably, in the first mode, images with partially
overlapping contents are recorded. The overlapping con-
tents are used to put together the images to form a com-
posite image, in which there is no duplication of con-
tent. Suitably, the putting-together is carried out with

15   the aid of a signal-processing unit which, for example,
may contain software for this purpose. By virtue of the
fact that the overlapping content is used for putting
together the images, the device need not contain any
means, e.g. wheels, for recording the position of the

20   device relative to the surface which is being imaged or
for measuring the distance between the images. Moreover,
the device can be moved at varying speeds while still
permitting the images to be put together into a composite
image.

25   The putting-together of the images is preferably
carried out horizontally as well as vertically. This has
the advantage that the device can be held at different
angles and even be turned while being passed over the
surface and yet the images can be put together well

30   enough that the characters in the composite image can be
identified and OCR processed.
       The signal-processing unit preferably comprises
software for identifying characters in the composite
image and for storing the same in the device in charac-

35   ter-coded format, preferably ASCII code. The character
identification is advantageously carried out with the aid
of a neural network. Storing in character-coded format

requires considerably less memory space than if the same
amount of information is stored, for example, as a bitmap
image.

In order to project onto the sensor surface a clear
5   image of the information to be recorded, i.e. the surface
over which the device is passed in the first mode, or of
the object located at a distance in the second mode, the
device preferably comprises at least one lens means,
which is adjustable between a first position in the first
10   mode and a second position in the second mode. In this
way, two foci are provided for the device, i.e. two dif-
ferent imaging distances each providing a sharp image on
the sensor surface. One focus is preferably used in the
first mode where an object is located adjacent to the
15   device and the other is preferably used in the second
mode where an object is located at a distance from the
device. The second position can suitably allow imaging of
objects at distances of between 0.5 m and infinity. The
different foci enable imaging of surfaces or objects at
20   different distances from the device. The lens means may
comprise one or more adjustable lenses. The device may
contain one or more fixed lenses in addition to the one
or more adjustable lenses. This embodiment is intended
in the first place for the case where the device has a
25   single light-sensitive sensor which is common for both
modes.

In another embodiment, the device comprises a lens
means, the position of which is variable for providing
a variable focus or an autofocus function. This enables
30   sharp imaging of an object located at an optional dis-
tance.

Furthermore, in an advantageous embodiment, the
device is adapted to effect the imaging in the first mode
with a lower resolution than the imaging in the second
35   mode. This can, for example, be achieved in the first
mode by making passive some of the sensor elements of the
sensor or by saving only a part of the sensor values

which are recorded by the sensor, or by using only a part
of the saved sensor values in the subsequent processing
of the images, such as in connection with the putting-
together. The advantage of this embodiment is that it
5   is possible to achieve faster, yet reliable, putting-
together of the images in the first mode if their reso-
lution is lower.

Moreover, the device advantageously comprises a
transceiver for wireless communication with an external
10   unit. In this way, information can be transferred between
the device and, for example, an external computer. The
transceiver can be an IR transceiver, a mobile radio
transceiver, or some other suitable transceiver.

To make the device easy to handle in all types of
15   recording situations it is suitably of the hand-held
type. This also expands its field of application consi-
derably.

In a preferred embodiment, the device also comprises
identification means for identifying the extent of the
20   imaging. The identification means may, for example, com-
prise a display mounted on the device, or one or several
luminous spots projected from the device onto the object
for defining the extent of the imaging. By the fact that
the user gets an idea of what the image of the object
25   will look like once it is recorded, the chances of
obtaining an accurate imaging result will be substantial-
ly better.

Brief Description of the Drawings

The invention will be described in more detail below
30   with reference to the accompanying schematic drawings
showing, by way of example, a presently preferred embodi-
ment of the invention.

Fig. 1 schematically shows a first embodiment of
a device according to the invention;
35   Fig. 2 is a block diagram of the electronic cir-
cuitry in an embodiment of a device according to the
invention;

Fig. 3 is a flowchart showing how the device is intended to function in the first mode;

Fig. 4 is a flowchart showing how the device is intended to function in the second mode;

5   Fig. 5 schematically shows a second embodiment of a device according to the invention.

Description of a Preferred Embodiment
Structure of the Device

In the embodiment of the device according to the

10   invention shown in Fig. 1, it comprises a casing 1 having approximately the same shape as a conventional highlighter pen. One short side of the casing has a window 2.

In the first mode of the device, the so-called scanning mode, the window 2 is intended to abut against or be

15   held directly adjacent to a surface which one wishes to image. This surface can, for example, consist of a sheet of paper from which text is to be recorded. In the second mode of the device, the so-called camera mode, the window is intended to be directed at an object which is located

20   at a distance and which one wishes to image.

The dimensions of the window 2 determine the size of the surface which can be imaged in the first mode. In the second mode, the dimensions of the window 2 only constitute a partial factor when determining which objects can

25   be recorded. Another partial factor of equal importance in the second mode is the distance to the object which the user wishes to image by means of the device.

The window 2 forms an acute angle to the longitudinal axis of the device so that in the first mode the user

30   is guided to hold the device at a predetermined angle to the underlying surface. Furthermore, the window 2 is somewhat recessed in the casing 1 so that is does not wear against the underlying surface when the device is used in the first mode.

35   The casing 1 essentially contains an optics part 3, an electronic circuitry part 4, and a power supply 5.

The optics part 3 comprises a light-emitting diode
(LED) 6, an adjustable lens system 7, and a light-sensi-
tive sensor 8 which constitutes the interface with the
electronic circuitry part 4.

5   The LED 6 is preferably used in the first mode where
its task is to illuminate the part of the surface which
is currently located under the window. A diffuser 9 is
mounted in front of the LED 6 for diffusing the light. In
the second mode, the object being imaged is preferably
10   illuminated by means of other external light sources in
the vicinity of the object.

The task of the lens system 7 is to project as
accurately as possible an image of the surface located
under the window 2, or of the object located within the
15   field of vision of the window on the light-sensitive
sensor 8. In connection with the adjustment between the
two modes, the lens system 7 is moved between two posi-
tions so that two different foci are provided. Fig. 1
shows the lens system 7 in the first position A. The
20   second position B is indicated, by way of illustration,
by dashes extending from the lens system. The lens system
7 can be moved in the same way as in a camera with two
foci. Moreover, if required, the lens system 7 will
reduce the image so that it will fit on the light-sen-
25   sitive surface of the sensor 8.

In this example, the light-sensitive sensor 8 com-
prises a two-dimensional, square CCD unit (CCD = charge
coupled device) with a built-in A/D converter. Such sen-
sors are commercially available. In this case, the sensor
30   8 is mounted at a small angle to the window 2 and on its
own printed circuit board 11.

The power supply to the device is obtained from a
battery 12 which is mounted in a separate compartment 13
in the casing.

35   The block diagram in Fig. 2 schematically shows the
electronic circuitry part 4. This comprises a processor
20, which by the intermediary of a bus 21 is connected

to a ROM 22, in which the programs of the processor are
stored, to a read/write memory 23, which constitutes the
working memory of the processor and in which the images
from the sensor as well as the characters identified and
5   interpreted in the first mode are stored, to a control
logic unit 24, as well as to the sensor 8, the lens sys-
tem 7, and the LED 6.

The control logic unit 24 is in turn connected to
a number of peripheral units, comprising a display 25,
10   which is mounted in the casing, an IR transceiver 26 for
transferring information to/from an external computer,
buttons 27, by means of which the user can control the
device, a tracer LED 28 which emits a light beam, making
it easier for the user to follow the text, as well as an
15   indicating device 29, e.g. a couple of LEDs, indicating
which mode the device is in and whether or not recording
is taking place. Control signals to the memories, the
sensor, and the peripheral units are generated in the
control logic unit 24. The control logic also handles
20   generation and prioritisation of interrupts to the pro-
cessor. The buttons 27, the IR transceiver 26, the dis-
play 25 and the tracer LED 28, and the LED 6 are accessed
by the processor writing and reading in the register in
the control logic unit. The buttons 27 generate inter-
25   rupts to the processor 20 when they are activated.

Operation of the Device in the First Mode

In the first mode, the device operates as follows.
Suppose that a user wishes to record text from a sheet
of paper. In this case, he holds the device against the
30   sheet in the location where he wishes to start recording
a character sequence. He presses a button 27 to activate
the device and passes the latter over the text he wishes
to record, following the text in the same way as when one
reads the text. The tracer LED 28 emits a light beam
35   which facilitates following the lines. When the user
activates the device, the processor 20 commands the LED 6
to begin generating strobe pulses at a predetermined fre-

quency of 25 Hz, whereupon the sensor records images with
partially overlapping contents which are stored in the
read/write memory 23. However, text which is stored in
the form of images requires a large amount of memory
5   space. Consequently, to save memory space in this mode,
the characters in the images are identified and stored
with the aid of ASCII code. When the user has passed the
device over the selected text or has come to the end of a
line, he lifts the device off the sheet and releases the
10 activating button, whereupon the processor 20 turns off
the LED 6. When the selected text has been recorded, the
user can control the device to show the recorded text
on the display 25 or to transfer the text to an exter-
nal computer by the intermediary of the IR transceiver
15 26. The possibility of showing the scanned information
directly on the display has proven very important since a
user often wishes to verify that the correct information
has been scanned.

    The flowchart in Fig. 3 shows how the device is
20 adapted to work in the first mode. In step 301, images
with overlapping contents are recorded with the aid of
the above device and are stored in a current image area
in the read/write memory 23. The images are stored as
images, i.e. with the aid of a plurality of pixels, each
25 having a grey scale value in a range from white to black.

    As soon as an image has been stored in the current
image area, the putting-together of the image with the
previous image is suitably commenced, step 302, if such
an image is available. If there is no previous image, the
30 current image is entered directly into a line image area
in the read/write memory.

    In order to determine how the current image is to
be put together with the previous image so that the best
match is achieved between the contents of the images,
35 every possible overlap position between the images is
examined, at the pixel level, and an overlap measurement
is determined as follows:

1) For each overlapping pixel position, the grey
scale values of the two relevant pixels are added up if
the latter are not white. Such a pixel position in which
none of the pixels are white is designated a plus posi-
5 tion.

2) The grey scale sums for all the plus positions
are added up.

3) The neighbours of each pixel position are exa-
mined. If an overlapping pixel position is not a neigh-
10 bour of a plus position and consists of a pixel which is
white and a pixel position which is not white, the grey
scale value of the non-white pixel is subtracted, pos-
sibly multiplied by a constant, from the sum in point 2).

4) The overlap position providing the highest over-
15 lap measurement as stated above is selected. In the
resulting composite image the mean value of the grey
scale value of the overlapping pixels is used. In this
way, noise can be suppressed in the overlap area. The
putting-together is thus carried out both vertically and
20 horizontally. If it is detected that, when being put
together, the images do not end up on a horizontal line,
the composite image is suitably adjusted so that it
becomes horizontal, for example by turning the composite
image.

25   Our Swedish patent application No. 9704924-1 and
the corresponding US Application No. 024 641, describe
an alternative way of matching the images in order to
find the best overlap position. The content of these
applications is herewith incorporated by reference.

30   The composite image gradually develops in the line
image area in the read/write memory. It is preferred that
the line image area be big enough to store an A4 line of
normal typewritten text.

In step 303, the software of the processor 20
35 divides the composite image in the line image memory
area into sub-images each containing only one charac-
ter. The purpose of this is to create input signals to

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a neural network software which is to interpret the char-
acters. The division is effected by adding up the grey
scale values of the pixels for each pixel row and each
pixel column in the composite image. By studying the
5   local intensity minima for the row sums and column sums
thus obtained, boundaries can be determined for the
extent of each character in the image.

Subsequently, in step 304, each character in the
composite image of the character sequence imaged is
10   interpreted. The grey scale values of the pixels which
together constitute a sub-image containing only one
character are fed as input signals to a neural network.
Each output from the neural network represents a charac-
ter which the network can identify. The output from the
15   network which has the highest output signal is chosen and
the character thus chosen is stored in step 305 using a
predetermined character code format, for example ASCII
code, in the read/write memory 23 in a memory area for
interpreted characters. When the character identification
20   and storing in character-coded format is completed, the
processor activates the indicating device 29 to inform
the user that it is ready to record a new character
sequence, step 306. Subsequently, it goes back to step
301.

25   In the first mode, the steps described above are
thus carried out by the processor 20 with the aid of the
associated units and suitable software. Such software can
be created by the skilled person with the aid of the
above instructions. The character recognition is perform-
30   ed with the aid of neural network software, which is
adapted in a suitable manner. Neural network software is
commercially available from, for example, MATLAB Neural
Network Toolbox, The MathWorks Inc., 24 Prime Park Way,
Natick, MA 01760, USA.

35   <u>Adjustment of the Device between the two Modes</u>

Suppose that the user now wishes to supplement the
scanned text with an image of an object. In this case,

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he indicates this by pressing the button 27. Then lens
system is then moved to the position B. This movement
results in the focus of the device being changed so that
a clear image of an object located at a distance can be
5   projected onto the light-sensitive surface of the sensor
8.

Operation of the Device in the Second Mode

       In the second mode, the device operates as follows.
The user directs the window of the device at the object
10   which is located at a distance and which he wishes to
image. On the display 25 of the device, the user can see
the image which will be recorded. When the user is satis-
fied with the appearance of the image, he presses a but-
ton 27 to activate the device which then records an image
15   of the object and stores the image in image format in the
memory 22. When the image of the object has been record-
ed, the user can control the device to either show the
recorded image on the display 25 or transfer the image to
an external computer by the intermediary of the IR trans-
20   ceiver 26. The recorded image can then be supplemented
with additional text information by the user setting the
device to the first mode and recording text or other
characters. Subsequently, the text and image information
recorded can be shown either on the display 25 of the
25   device or on an external computer.

       The flowchart in Fig. 4 shows how the device is
adapted to operate in the second mode. In step 401, the
extent of the image is indicated on the display 25 of the
device. When the user is satisfied with the appearance of
30   the image, he presses the button 27 and, in step 402, the
image is then recorded. The image is recorded in the cur-
rent image area of the read/write memory with the aid of
a plurality of pixels, which can have either grey scale
values from white to black, or colour values. The user
35   can then choose whether or not he wishes to keep the cur-
rent image. If the user decides to keep the image, the
process continues along the solid line to step 403, in

which the image is stored in the memory 23. When the
image has been stored, the device indicates, in step 404,
that it is ready to scan a new image. If the user does
not wish to keep the image, the process continues, from
5   step 402, along the dashed line back to step 401 in order
for a new image to be scanned.

Alternative Embodiments

        The present invention can, of course, be modified
within the scope of the appended claims. The lens means
10   may, for example, comprise a lens which is put on like a
"cap" on the front of the device in one of the modes.

        In the embodiment described above, the device has a
single light-sensitive sensor which is used in the first
as well as the second mode. As mentioned above, however,
15   the device can alternatively have a sensor for each mode.
Fig. 5 shows schematically how the embodiment in Fig. 1
could be modified to have two sensors. In the embodiment
in Fig. 5, the device has a second window 2' in the side
of the casing, a second light-sensitive sensor 8' with a
20   two-dimensional sensor surface, and a second lens means
7' which can have a variable focus. The electronic cir-
cuitry part is the same as in the embodiment in Fig. 1.
When adjusting from one mode to the other, an adjustment
takes place of which sensor is activated for imaging and
25   an adjustment takes place of from which sensor the elec-
tronic circuitry part collects images.